

Not so close but still extremely loud: Recollection of the world trade center terror attack and previous hurricanes moderates the association between exposure to hurricane sandy and posttraumatic Stress Symptoms

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Abstract

Background: The present study examined whether recollections of the World Trade Center (WTC) terror attack and previous hurricanes moderated the relationship between exposure to Hurricane Sandy and related posttraumatic stress disorder (PTSD) symptoms.

Methods: An online sample of 1000 participants from affected areas completed self-report questionnaires a month after Hurricane Sandy hit the East Coast of the United States. Participants reported their exposure to Hurricane Sandy, their PTSD symptoms, and recollections of the WTC terror attack and previous hurricanes elicited due to Hurricane Sandy.

Results: Exposure to Hurricane Sandy was related to PTSD symptoms among those with high level of recollections of the WTC terror attack and past hurricanes, but not among those with low level of recollections.

Conclusions: The aftermath of exposure to Hurricane Sandy is related not only to exposure, but also to its interaction with recollections of past traumas. These findings have theoretical and practical implications for practitioners and health policy makers in evaluating and interpreting the impact of past memories on future natural disasters. This may help in intervention plans of social and psychological services. © 2014 Elsevier Inc. All rights reserved.

1. Introduction

Mass traumas are a specific type of traumatic experience and have lately received a great deal of theoretical attention [1]. Understanding variations in risk factors is important

when planning programs that respond to such events. Although most people are expected to be exposed to traumatic experience during their lives, and more than 15% to disasters, less than 5% develop PTSD after exposure to natural disaster [2]. However, several risk factors, including intensity, duration, and type of exposure, may double or even triple this probability [1]. One additional risk factor for developing post-traumatic stress may be the recollection of previous trauma [3].

Trauma recollections form part of the criterion B symptoms for the definition of PTSD in DSM-5 [4]. Whereas previous exposure to traumatic events is known to be related to higher vulnerability to PTSD [5–7] less is known about the effect of recollections of previous trauma elicited due to a present event. The mnemonic model of PTSD suggests that current memory of a traumatic event

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changes with time and situation, and that it is the memory for the event and not the event itself that determines PTSD symptoms [8]. It can be assumed that past recollections serve as predisposing factors that may change the current memory of the event, and therefore impact on PTSD symptoms. Moreover, higher vulnerability to traumatic exposure due to previous exposure has been interpreted as supporting a ‘sensitization’ process, that is, the greater responsiveness that occurs when exposed to subsequent stressors [9]. Recently, it has been suggested that recollections of a trauma are dynamic and can change [10]. Individuals who were either resilient or recovered over time recalled more benign recollections of an event over time; individuals who experienced chronic PTSD symptoms had more traumatic recollections [11]. The present study explored the role of recollections of both natural and human-made disasters in moderating the association between exposure to a natural disaster and PTSD symptoms one month later.

1.1. Prior disasters and Hurricane Sandy

Natural disasters significantly increase the risk for a broad range of psychiatric disorders, such as posttraumatic stress disorder (PTSD), anxiety disorders, depressive disorders, and suicidality [12–14]. The present study focuses on Hurricane Sandy, the largest sized Atlantic hurricane on record which struck the eastern coast of the United States on October 29, 2012. At least 285 people were killed along the path of the storm in seven countries, and more than a hundred in the United States alone. In the United States, Hurricane Sandy affected 24 states, with particularly severe damage in New Jersey and New York. The financial damage caused by the storm was estimated at 60 billion USD, making it the second costliest Atlantic hurricane [15].

Human-made disasters however can also cause considerable distress. Previous studies showed a substantial burden of acute PTSD and depression in Manhattan after the September 11 attacks [16]. Specific aspects of the WTC terror attack, such as its scale, unpredictability, novelty as a threat, and implications for future safety, together with frequent government warnings of future attacks, all increased the potential risk for being harmed in additional terror attacks [17]. Whereas the evidence suggests that the burden of PTSD among populations exposed to disasters is substantial [18], it is not yet certain the extent to which, in a non-clinical sample of individuals residing in the New-York Metropolitan, recollections of previous trauma exposure will moderate the association between the level of a new exposure and level of PTSD symptoms.

We suggest three hypotheses. First, we suggest that, compared to those with low exposure, those who were highly exposed to Hurricane Sandy would report stronger past recollections of adversity of a similar nature (natural disasters), but also stronger recollections stemming from other adversities (e.g., man-made traumas). Here we focus on the World Trade Center (WTC) terror attack as both a major

national trauma in the United States but one with direct relevance to New York, with an estimated of 7.5% of the New York metropolitan population suffering from PTSD following the attacks [16]. Second, in line with the sensitization hypothesis discussed above, we hypothesize that higher level of exposure to Hurricane Sandy, as well as having higher level of recollections regarding previous hurricanes and the WTC terror attack, would be associated with higher level of PTSD symptoms regarding Hurricane Sandy. Finally, and in relation to the mnemonic model of PTSD [8] we anticipate that the association between reported exposure to Hurricane Sandy and PTSD symptoms level would be stronger among those with higher level of recollections regarding the WTC terror attack and previous hurricanes.

2. Methods

2.1. Participants and procedure

Following approval by the Institutional Review Board of the School of Social Work at Ariel University, we used an online survey sample of 1000 participants (response rate = 83.3% out of a potential 1200), aged 18 or older, who were drawn from affected states by Toluna (<http://www.toluna-group.com>), an Internet panel company.

The survey was conducted during the fourth week of November 2012, one month after Hurricane Sandy struck the eastern coast of the United States. Internet panels are increasingly used as a viable means of data collection [19] and their representativeness is comparable to data from probability-based general population samples [20]. To recruit the study participants, Toluna sent e-mails to invite potential participants from their databases to enroll in the current study following a screening process to ensure eligibility (based on age, place of living and English language). We used similar method employed in other medical and psychological studies [21,22].

Participants mean age was 45.16, SD = 14.30, range 18–82, with most respondents women ($n = 655$; 65.5%), married ($n = 606$; 60.6%) and white ($n = 846$; 84.6 %). Almost half had a college or higher education ($n = 455$; 45.5%). 299 (29.9%) participants reported high exposure to: 1) home damage or destruction, or 2) property or belongings loss or 3) had witnessed an injury related to Hurricane Sandy. For more details, see Table 1. 553 (55.3%) of the participants reported that, during the WTC attack, they: 1) stayed in Manhattan during 9/11, or 2) were in the vicinity of Ground Zero, or, 3) knew people who were injured or killed by the WTC terror attack (Table 1).

2.2. Measures

Using a self-report questionnaire, we assessed socio-demographic characteristics (age, gender, marital status, race, and education). As health status is well associated with

Table 1
Level of exposure to hurricane sandy and the WTC terror attack.

	Exposure to WTC terror attack		Exposure to Hurricane Sandy	
	yes	no	yes	no
Home was damaged, <i>n</i> (%)	212 (21.6)	768 (78.4)	276 (27.8)	718 (72.2)
Home was destroyed, <i>n</i> (%)	119 (12.0)	871 (88.0)	226 (22.7)	768 (77.3)
Lost personal property or belongings, <i>n</i> (%)	184 (18.7)	802 (81.3)	329 (33.3)	658 (66.7)
Witnessed an injury, <i>n</i> (%)	146 (14.8)	839 (85.2)	341 (34.5)	647 (65.5)

post-disaster outcomes including PTSD symptoms [23] we also added a single item, self-rated health (“poor”, “fair”, “good” “very good” or “excellent”) as a covariate in our analyses [24].

Disaster-related experiences regarding Hurricane Sandy and the WTC terror attack were coded dichotomously as “low” = no specific exposure or “high” = exposure to at least one of the reported items (Table 1).

Self-report recollections of 1986 Hurricane Gloria, 1992 Hurricane Andrew, and 2011 Hurricane Irene and recollection of the WTC terror attacks elicited due to Hurricane Sandy were rated on a Likert scale ranging from 0 “not at all” to 4 “very much” (see Table 2).

Posttraumatic Stress Disorder (PTSD) Symptoms were assessed by the Impact of Event Scale Revised (IES-R), a 22-item scale including PTS domains of intrusion, avoidance/numbing, and hyperarousal [25]. Respondents were requested to refer to symptoms resulting from exposure to Hurricane Sandy when reporting the IES-R items. Scores ranged from 0 to 88, with 33 or higher indicating a high level of PTSD symptoms [26]. Cronbach’s α was high for the IES-R (0.975). This scale was used in previous natural disasters and showed highly reliable psychometric properties [27,28].

2.3. Data analysis

Descriptive analyses (correlations and t-tests) were conducted first to examine the associations between PTSD symptoms and age, sex, marital status, race, education, and self-rated health. To test our first hypothesis we compared those who had low vs. high exposure to Hurricane Sandy on recollections of Hurricane Gloria, Hurricane Andrew, Hurricane Irene, and the WTC terror attack, using t-tests. To test our second hypothesis concerning predictors of low vs. high PTSD symptoms, we performed logistic regression analyses. Background characteristics (age, gender, marital

status [dichotomized into “unmarried” vs. “married or live in cohabitation”], race [white vs. non-white], education [secondary education vs. college or higher education], and self-rated health) were entered in Step 1. In Step 2, number of exposures to Hurricane Sandy (from 0 to 4) and recollections (previous hurricanes and the WTC terror attack) were included in the regression. Step 3 included the respective two-way interaction between exposure to Hurricane Sandy and the recollections. When significant interactions were found, we used commonly accepted recommendations for the exploration of interactions in logistic regressions [29]. We conducted the regressions regarding recollections of the WTC terror attack once again adding in Step 2 the number of exposure types to the WTC terror attack in order to control for the contribution of actual exposure to WTC terror attack. We used Nagelkerke R^2 as an estimate of proportional reduction in the absolute value of the log-likelihood measure.

3. Results

The average level of PTSD symptoms following exposure to Hurricane Sandy was 18.54; SD = 20.26. High PTSD symptoms (IES-R \geq 33) was prevalent in 23.6% ($n = 236$) of the respondents. A significant but weak negative association was found between age and PTSD symptoms ($r = -.13$; $P < .000$), and significant but small differences in PTSD symptoms level were found between white and non-white respondents ($t = -.282$; $P < .01$). No significant difference in PTSD symptoms level was found between men and women ($t = -.78$; $P = .439$), the married vs. unmarried ($t = -.62$; $P = .534$), those with low vs. high education ($t = -.20$; $P = .839$), and there was no significant correlation between self-rated health and PTSD symptoms ($r = -.06$; $P = .075$).

In line with the first hypothesis, exposure to Hurricane Sandy was related to higher level of recollections of previous

Table 2
Recollections regarding previous hurricanes and the WTC terror attack.

Since Hurricane Sandy, how often do you think of	Not at all	A little bit	moderately	Quite a lot	Very much
Hurricane Gloria (1986)? <i>n</i> (%)	682 (68.5)	160 (16.1)	84 (8.4)	49 (4.9)	21 (2.1)
Hurricane Andrew (1992)? <i>n</i> (%)	609 (61.5)	212 (21.4)	111 (11.2)	43 (4.3)	16 (1.6)
Hurricane Irene (2011)? <i>n</i> (%)	243 (24.5)	262 (26.4)	212 (21.4)	165 (16.6)	110 (11.1)
The WTC terror attack? <i>n</i> (%)	379 (38.2)	225 (21.7)	158 (15.9)	131 (13.2)	100 (10.1)

Table 3

Logistic regression coefficients for predicting PTSD symptoms by exposure to hurricane sandy, past recollections, and their interaction.

Factors	Recollection Gloria		Recollection Andrew		Recollection Irene		Recollection WTC	
	B	OR (95% CI)	B	OR (95% CI)	B	OR (95% CI)	B	OR ^a (95% CI)
Step 1								
Age, years	-.02**	.98 (.97–.93)	-.02**	.98 (.97–.99)	-.02**	.98 (.97–.93)	-.02**	.98 (.97–.99)
Sex	.39*	1.47 (1.07–2.02)	.40*	1.49 (1.09–2.05)	.36*	1.45 (1.05–1.98)	.40*	1.49 (1.09–2.05)
Marital Status	-.10	.91 (.66–1.25)	-.10	.90 (.66–1.24)	-.11	.90 (.66–1.23)	-.09	.92 (.67–1.26)
Race/ethnicity	.44*	1.56 (1.05–2.31)	.47*	1.61 (1.08–2.39)	.47*	1.60 (1.07–2.38)	.45*	1.57 (1.05–2.33)
Education	.12	1.12 (.83–1.53)	.12	1.13 (.83–1.54)	.09	1.09 (.81–1.49)	.11	1.12 (.82–1.51)
Self-Rated Health	-.21*	.81 (.67–.99)	-.20	.82 (.67–1.00)	-.20	.82 (.67–1.00)	-.21*	.81 (.66–.99)
Step 2								
Exposure to Hurricane Sandy	.31***	1.38 (1.22–1.55)	.33***	1.39 (1.23–1.58)	.39***	1.47 (1.31–1.66)	.37***	1.45 (1.29–1.64)
Recollection	1.68***	5.35 (3.85–7.43)	1.82***	6.18 (4.40–8.68)	1.92***	6.85 (3.82–12.26)	1.94***	6.95 (4.49–10.77)
Step 3								
Exposure to Hurricane Sandy × Recollection	.52**	1.68 (1.19–2.39)	.48**	1.61 (1.16–2.24)	.44**	1.54 (1.18–2.03)	.37*	1.44 (1.04–1.99)
Nagelkerke R ²		.25		.27		.20		.24

Abbreviations: IES-R, Impact of Event Scale Revised. OR, Odds Ratio. The factors assessed were Recollections regarding Gloria, Andrew, Irene and WTC.

* P ≤ 0.001.

** P < 0.05.

*** P ≤ 0.01.

natural, as well as man-made, adversities. Compared to those who reported low exposure, those who were highly exposed to Hurricane Sandy reported more recollections of Hurricane Gloria ($t = 4.33$; $P < 0.0001$), Hurricane Andrew ($t = 5.32$; $P < 0.0001$), Hurricane Irene ($t = 6.48$; $P < 0.0001$), and the WTC terror attack ($t = 2.98$; $P < 0.01$).

In line with the second hypothesis, logistic regressions showed that a high level of PTSD symptoms was predicted by greater exposure to Hurricane Sandy (controlling for demographics and elicited recollections of the WTC terror attack) ($OR = 1.45$, $P < .001$), and recollections of previous hurricanes and the WTC terror attack (controlling for demographics and exposure to Hurricane Sandy) ($OR = 5.35$, $P < .001$; $OR = 6.18$, $P < .001$; $OR = 6.85$, $P < .001$; $OR = 6.95$, $P < .001$ for recollections of Hurricane Gloria, Andrew, Irene and the WTC terror attack, respectively). For more details, see Table 3.

Finally, the exposure to Hurricane Sandy × recollections interaction significantly predicted PTSD symptoms in all cases. The interaction was significant for recollections of Hurricane Gloria, Andrew, Irene and the WTC terror attack ($OR = 1.683$, $P < .01$; $OR = 1.611$, $P < .01$; $OR = 1.544$, $P < .01$; $OR = 1.440$, $P < .05$, respectively). These results were significant for recollections of the WTC attack even after controlling for the number of exposure types to the WTC. To further explore the Exposure to Hurricane Sandy × WTC terror attack recollection interaction, exposure to Hurricane Sandy was regressed on PTSD symptoms separately for those who did and those who did not report recollections regarding the WTC terror attack, controlling for covariates. For those who did not report recollections regarding the WTC terror attack exposure to Hurricane Sandy did not predict PTSD symptoms ($B = 0.720$, $OR = 2.054$, 95% CI [0.903, 4.675], $p = .086$). However, for those who reported recollections regarding the WTC terror attack,

exposure to Hurricane Sandy significantly predicted PTSD symptoms ($B = 1.259$, $OR = 3.522$, 95% CI [2.408, 5.153], $p < .0001$). The same trend was found when exploring the interactions between exposure to Hurricane Sandy and recollections of the previous hurricanes.

4. Discussion

The current study is the first to examine the impact of recollections of a human-made traumatic event on the relationship between natural disaster exposure and PTSD symptoms. Compared to their counterparts with low exposure to Hurricane Sandy, those highly exposed to Hurricane Sandy reported higher level of recollections of previous natural disasters, as well as the WTC terror attack. Additionally, the relationship between exposure to Hurricane Sandy and PTSD symptoms was moderated by the level of recollections of these previous events.

Research on PTSD has recently focused on specific types of traumas, such as natural disasters or human-made disasters [6,16]. Although the prevalence of PTSD in the aftermath of a natural disaster is often lower than the rates following human-made traumas [18], studies have shown that previous lifetime traumatic exposure and exposure intensity are associated with one's traumatic condition [5,30]. Therefore, studies conducted in the aftermath of hurricanes in the United States have shown substantial psychological consequences among those exposed [14,31]. The present study adds to the literature by showing that those PTSD symptoms are constructed after a new exposure not only by the event itself, but also by previous recollections. Furthermore, current exposure to a natural disaster is associated with level of national and personal recollections of both previous human-made and natural adversities. Most importantly, this study shows that present exposure is related

to PTSD symptoms, especially among those who hold higher level of recollections of past adversities. In line with recent findings those with chronic PTSD symptoms are also those who have higher level of traumatic recollections elicited by the new exposure [11]. These past recollections serve as risk factors when they are the same nature as the present exposure, but also when they are of a different nature. In line with the mnemonic model of PTSD [8], it seems that past recollections may change one's memories of a recent exposure. This change in the individual's memories, rather than the event itself, may contribute to the level of PTSD symptoms. Practitioners and policy makers should consider the traumatic historical nature of the area where the exposure occurred and account for recollections of past adversity when interpreting the effects of present disasters. These considerations may be also part of the evaluation and intervention plans of social and psychological services.

We recognize several limitations. Our report was based on a web-enabled cross-sectional research with oversampling of women, with neither baseline measures nor long-term outcomes. PTSD symptoms were self-reported and no comparison group was available. As we have not examined whether the recollections existed before exposure to Hurricane Sandy, it is possible that those who developed PTSD symptoms reported more recollections as a result of their current distress. Future longitudinal studies should examine the direction of this causality. Moreover, whereas we have measured the recollections' frequency, we have not measured its valence (as good or bad content) or intensity.

5. Conclusions

The current investigation provides important evidence associating previous recollections with the relationship between exposure to natural disaster and PTSD symptoms. These findings provide a larger historical and social perspective to the known associations between exposure to natural disaster and the development of PTSD symptoms. This perspective which suggests that PTSD is not merely a result of the new exposure, suggests a need for future studies that explore the contribution of a wide psychological, historical and social factors to the construction of PTSD. This should then be considered by policy makers and social services bodies when considering and evaluating the consequences of a natural trauma.

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